



# Water Quality Monitoring Annual Report 2016



## Big Creek Watershed

Mark Nowosad  
Angele Leduc  
Jeffrey Van Zandvoort

# Water Quality Objective Monitoring, Big Creek Watershed, 2016

## Hydrologic and Geomorphic Characteristics of the Big Creek Drainage Basin

Big Creek, a major tributary to the Yukon River, drains an area of approximately 1750 square kilometers and has an overall channel length of approximately 77 km. The drainage basin is located west-south-west of Minto and north-west of Carmacks.

Big Creek has its headwaters in the Dawson Range and eventually drains into the Yukon River below the old town site of Minto. There are several areas of exposed bedrock forming high rock bluffs along the creek. Above the Water Survey of Canada (WSC) gauging station, the creek is entrenched within a narrow valley, while below the gauging station the creek flows through a low flat area before entering the Yukon River. The creek banks are generally lined with spruce, willows and poplars. Most of the creek flows over a bed of coarse gravel, underlain by shallow bedrock. There has been very little channel migration evident along the lower portion of the creek, below the confluence with Seymour Creek, but above this point, Big Creek has been prone to heavy flooding and substantial migration has occurred.

The Water Survey of Canada gauging station (09AH003) is located 9.7 km from the confluence of Big Creek with the Yukon River.

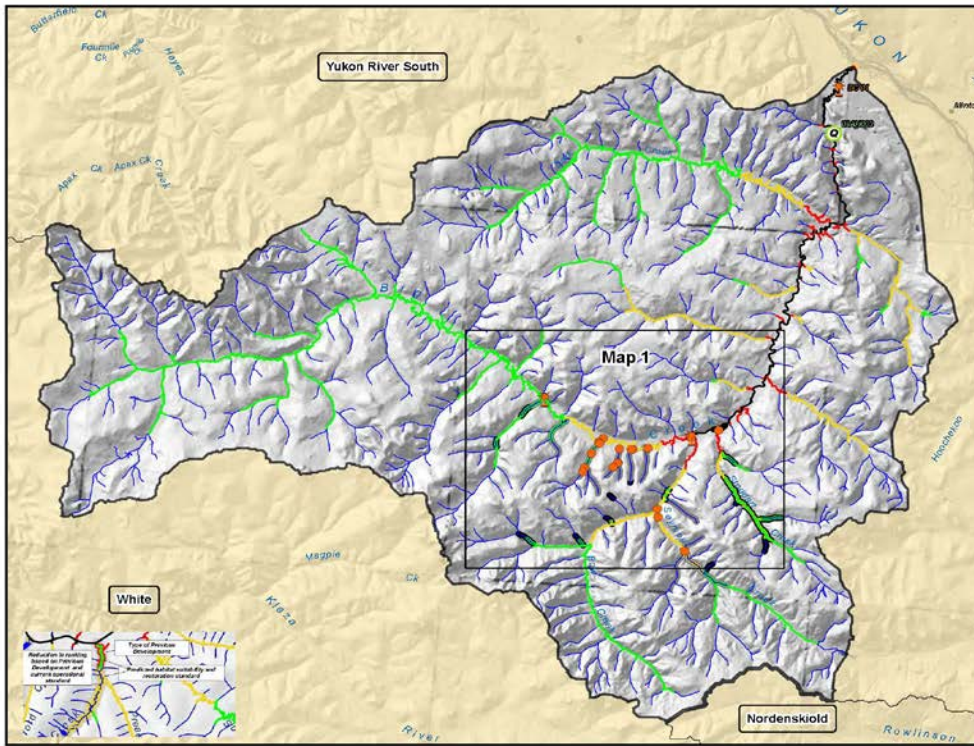
Topographical drainage Basin	1750 Sq. Kilometers
Area of Lakes	0%
Area of Forest	98%
Channel Length	77 Kilometers
Terrain	75% non-glaciated / 25% glaciated

In 2016, water samples were collected at 8 different sites in the Big Creek basin. Sampling commenced on May 31<sup>st</sup>, 2016 and a total of 468 samples were collected up until the end of the season on September 17<sup>th</sup>, 2016. A combination of automatic composite sampling and grab sampling methods were used in the basin. An additional 16 samples were collected by CMI staff during routine mine inspections.

Atmospheric data was collected using four portable weather stations; one located near the mouth of Big Creek, the second on Seymour Creek above all mining, a third near the mouth of Seymour Creek and a fourth on Big Creek downstream of Mechanic Creek.

Basin total flow data was provided to us by the Water Survey of Canada station located near the mouth of Big Creek. Flow data for the individual tributaries to Big Creek was collected at the time of sampling by the staff of E.M.R CMI using the methodology outlined in the Yukon Placer Secretariats, Water Quality Monitoring Protocol. Level data was collected at Seymour Creek below all mining and at the mouth of Bow Creek.

# Water Quality Objective Monitoring, Big Creek Watershed, 2015



### Big Creek Watershed Water Quality Objective Monitoring Sites 2015 (Category A) Overview

**Monitoring Sites**

- Energy Mines and Resources Weather Station and Sampling Site
- Energy Mines and Resources Sampling Site
- Water Survey of Canada Station
- Community Services Weather Station

**Stream Reach Classification**

- Water Quality
- Freshwater Fisheries Production Zone
- Moderate/Low Suitability
- Moderate/Moderate-High Suitability
- Moderate-High Suitability
- Chinook Salmon Production
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)

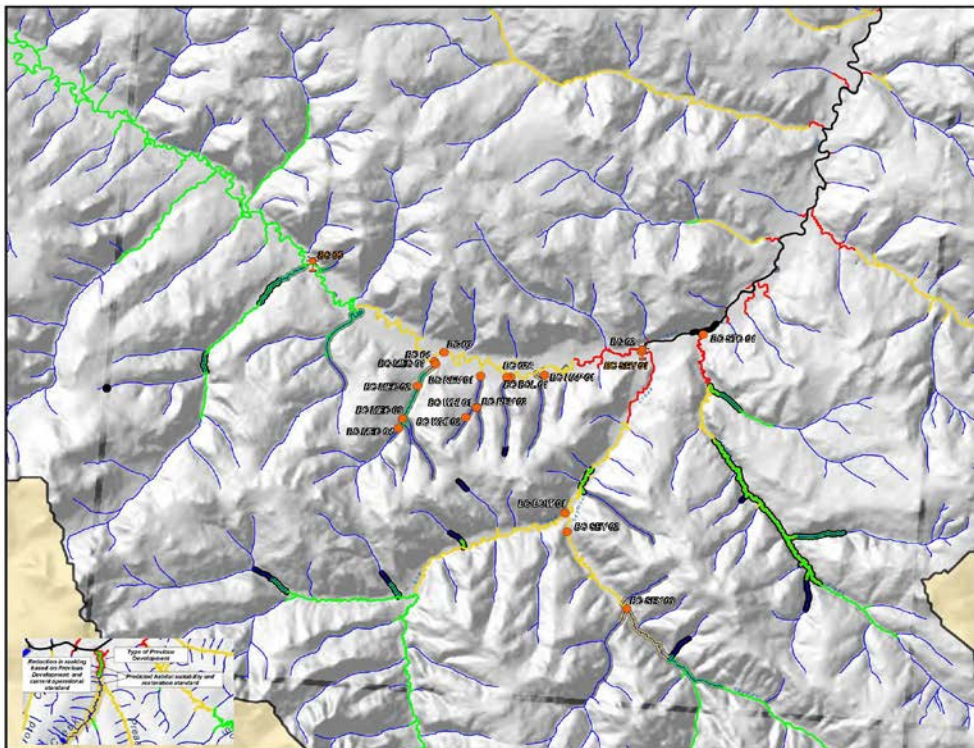
**Development**

- Current
- Historical
- Extensive

This map is provided to depict the location of water quality and weather monitoring sites in relation to streams classified using the Yukon Habitat Suitability Model and is not intended for any other use. Under no circumstances will the Government of Canada or Yukon Government be held liable for any claims or damages, including, but not limited to, special, incidental, consequential, or other damages, based on any use of information contained on this map, including, without limitation, any lost profits, business interruption, or loss of information.

0 2 4 8 12 Kilometres

**Yukon**  
YUKON PLACER SECRETARIAT



### Big Creek Watershed Water Quality Objective Monitoring Sites 2009 (Category A) Map 1

**Monitoring Sites**

- Energy Mines and Resources Weather Station and Sampling Site
- Energy Mines and Resources Sampling Site
- Water Survey of Canada Station
- Community Services Weather Station

**Stream Reach Classification**

- Water Quality
- Freshwater Fisheries Production Zone
- Moderate/Low Suitability
- Moderate/Moderate-High Suitability
- Moderate-High Suitability
- Chinook Salmon Production
- Areas of Special Consideration (Ecological)
- Areas of Special Consideration (Cultural)

**Development**

- Current
- Historical
- Extensive

This map is provided to depict the location of water quality and weather monitoring sites in relation to streams classified using the Yukon Habitat Suitability Model and is not intended for any other use. Under no circumstances will the Government of Canada or Yukon Government be held liable for any claims or damages, including, but not limited to, special, incidental, consequential, or other damages, based on any use of information contained on this map, including, without limitation, any lost profits, business interruption, or loss of information.

0 1 2 4 6 Kilometres

**Yukon**  
YUKON PLACER SECRETARIAT

**Site Codes and Global Position of Water Quality Sampling Locations in the Big Creek Watershed**

<b>SITE CODE</b>	<b>LOCATION</b>	<b>LAT_Y</b>	<b>LONG_X</b>
BI01	Big Creek near the mouth at bridge	62.59901	-137.01318
BI02	Big Creek u/s of Seymour Creek	62.35579	-137.1779
BI03	Big Creek u/s Happy Creek and d/s Boliden Creek	62.34543	-137.25592
BI04	Big Creek u/s Boliden Creek d/s Mechanic Creek	62.35129	-137.29741
BI05	Upper Big Creek u/s of Mechanic Creek	62.3484	-137.30298
BI06	Upper Big Creek above all mining (AAM)	62.37486	-137.38141
BI_BO01	Boliden Creek mouth at road culvert	62.34525	-137.25809
BI_SE_BO01	Bow Creek mouth	62.306	-137.21629
BI_HA01	Happy Creek mouth	62.34672	-137.23535
BI_ME01	Mechanic Creek mouth	62.34764	-137.30185
BI_ME02	Mechanic Creek	62.34085	-137.31169
BI_ME03	Mechanic Creek at road crossing	62.33065	-137.31941
BI_ME04	Mechanic Creek above all mining (AAM)	62.32771	-137.32123
BI_RE01	Revenue Creek mouth	62.34504	-137.27414
BI_RE02	Revenue Creek u/s of Whirlwind Creek	62.33569	-137.27481
BI_SE01	Seymour Creek mouth	62.3556	-137.177
BI_SE01A	Seymour Creek u/s of the mouth	62.31777	-137.2084
BI_SE02	Seymour Creek at road crossing	62.30057	-137.21416
BI_SE03	Seymour Creek above all mining (AAM)	62.2788	-137.17442
BI_RE_WH01	Whirlwind Creek mouth	62.33558	-137.27507
BI_RE_WH02	Whirlwind Creek above all mining (AAM)	62.33235	-137.28101
BI_ST01	Stoddart Creek mouth	62.36389	-137.14028

**Water Quality Objective monitoring, Big Creek Watershed – Summary**

Between 1998 and 2000, this basin was extensively monitored, providing us with a vast amount of baseline information at the time. Placer activities in this watershed have recently increased. Due to the greater interest in the area, and recent changes in mining locations and levels of activity, the Big Creek Watershed was designated a ‘*watershed of interest*’ for monitoring in 2014, 2015 and again in 2016. This means that a major proportion of our monitoring efforts for each season were planned in the basin and that more than one third of our monitoring equipment inventory was be deployed in the area, which meant many repeat visits to the watershed.

During the 2014 monitoring season, an attempt was made to keep these sites maintained and continuously monitored however, through a combination of equipment failure, site instability and finally widespread flooding in a large area of Big Creek that bared our access, only an insignificant amount of data was collected. The 2015 and 2016 sampling season were more successful and a significant amount of data and water samples were collected.

## Water Quality Objective Monitoring, Big Creek Watershed, 2016

In 2016, five automatic water-sampling stations were set up and operated from June 1st until shutdown on October 8<sup>th</sup> (Big Creek near the mouth, Big Creek downstream of Mechanic Creek, Bow Creek mouth, Seymour Creek upstream of the mouth, Seymour Creek above all mining [AAM]). As well, four portable weather-monitoring stations were set up to collect rainfall and temperature data (Big Creek near the mouth, Big Creek downstream of Mechanic Creek, Seymour Creek upstream of the mouth and Seymour Creek above all mining [AAM]). In addition to this equipment, newly acquired level monitoring instrumentation was installed at three sites, at the mouth of Bow Creek, just above the mouth of Seymour Creek and on Seymour Creek above all mining (AAM). This new monitoring equipment has provided us with additional data that correlates with the precipitation data collected via our portable weather stations and has allowed us to derive changes in stream flow and water velocity at these sites.

At three of the five Big Creek basin sites monitored during the season, the water quality met the minimum objectives set under the *Fish Habitat Management System*, while at the two other sites (Big Creek near the mouth and Mechanic Creek at the mouth), the water quality failed to meet the minimum water quality objectives. The average TSS concentration at the mouth of Big creek was 28.0 mg/L, 3.0 mg/L above the WQO of 25.0 mg/l. The average TSS concentration at the mouth of Mechanic Creek was 782.2 mg/L, well above the WQO of 200.0 mg/l however, it should be noted that only six samples could be collected during the season. On those occasions when the WQO were not met at both sites, and the Total Suspended Solids level was greater than the objective, there was a direct correlation between environmental conditions and the volume of solids in the water.

In most cases, rain fall, either as localised events or basin wide occurrences, increased the amount of surface run off and subsequent soil erosion from the land, increasing the input of sediment into the receiving waters. These increases occurred simultaneously at the time of the rain event or immediately in a period of one or two days after the rain event, as surface water continued draining from the land and ground water infiltrated the watercourse.

Increases in the volume of sediment laden ground and surface water entering the system add to the amount of sediment in the water course. The ability of the receiving water to dilute these inputs of sediment is negated by the re-suspension of stream bed material and by the further erosion of the streams banks that occurs along with the increased flows that are generated by the aftermath of these rain events.

All of these factors; precipitation leading to increased sediment input and increased flows from these rain events re-suspending and further eroding material, lead to an increase in suspended solids concentrations and a decrease in water quality.

The Fish Habitat Management System - Big Creek Watershed (Category A)

Sample Results that Exceed Water Quality Objectives for 2016

Sampling Station	BI01	BI_SE01A	BI02	BI03	BI04	BI_ME01	BI05	Other	Other	Other
Location Description	Mouth	Mouth	u/s BI_SE01	d/s BI_BO01	d/s BI_ME01	Mouth	u/s BI_ME01			
Type of sampling	Auto/Grab	Auto/Grab	Auto/Grab	Grab	Auto/Grab	Grab	Grab			
Lat Y	62.59901	62.35560	62.35579	62.35129	62.34840	62.34764	62.37486			
Long X	-137.01318	-137.17700	-137.17790	-137.29741	-137.30298	-137.30185	-137.38141			
Habitat Classification	High	Moderate-H	High	Moderate-M	Low	Moderate-H	Moderate-L			
Water Quality Objective (mg/L)	25	25	25	50	200	200	80			
Date of Sampling										
15-Jun-16	56.0	309.5			36.4					
16-Jun-16	108.0	53.2			0.0					
17-Jun-16	30.0	18.4			0.0					
22-Jun-16	2.0	27.2			16.0	675.0	6.0			
29-Jun-16	2.0	36.4			1.6					
30-Jun-16	2.4	31.2			1.6					
6-Jul-16	3.2	37.6			1.6					
7-Jul-16	21.2	52.4			9.6					
8-Jul-16	58.4	32.0			15.6					
9-Jul-16	38.4	76.8			5.2					
10-Jul-16	33.6	64.0			3.2					
11-Jul-16	50.0	9.6			116.0					
12-Jul-16	583.6	19.6			167.2					
13-Jul-16	228.4	14.4			49.2	109.2	31.6			
14-Jul-16	166.8	18.0			49.6					
15-Jul-16	61.6	12.8			18.8					
16-Jul-16	80.4	16.0			27.6					
17-Jul-16	42.4	6.8								
18-Jul-16	30.0	3.6								
24-Jul-16	74.8	38.4								
26-Jul-16	174.0	4.8								
27-Jul-16	97.6	3.6								
28-Jul-16	35.6	0.8								
30-Jul-16	15.6	35.6								
3-Aug-16	7.6	8.0			119.6	584.0	7.6			
8-Aug-16	31.2	0.8			14.0					
24-Aug-16	4.0	6.0			75.6	3,256.0	1.6			
25-Aug-16	82.8	2.0								
27-Aug-16	58.0	19.6								
29-Aug-16	41.2	1.2								
4-Sep-16	45.6	17.2								
<b>Total Seasonal Average TSS (mg/L) by site</b>	<b>28.0</b>	<b>14.2</b>	<b>NA</b>	<b>NA</b>	<b>18.9</b>	<b>782.2</b>	<b>9.3</b>			
<b>Number of days sampled</b>	<b>107</b>	<b>108</b>	<b>NA</b>	<b>NA</b>	<b>76</b>	<b>6</b>	<b>6</b>			
<b>Legend</b>	<b>Not continuously monitored</b>									
	<b>Water Samples that are: Above / Below the Water Quality Objective</b>									